

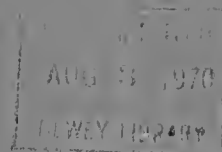
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HUMAN CAPITAL AND THE INDIAN PATTERN OF FOREIGN TRADE

by

Jagdish N. Bhagwati and Ranganath Bharadwaj

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Human Capital and the Indian Pattern of Foreign Trade¹

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The well-known Leontief paradox, consisting in the finding that the United States exports were labour-intensive, has been examined recently from a number of angles to reconcile it with the Heckscher-Ohlin theory's predictions.²

Among these efforts, an important line of analysis is to be traced to Leontief's own attempted reconciliation via the assertion that United States labour is thrice as efficient as foreign labour, so that the United States is actually labour, rather than capital, abundant. Leontief produced no independent evidence in support of this assertion: his conclusion that the Heckscher-Ohlin theory was therefore verified was thus methodologically unsound. However, his recognition of the non-homogeneity of labour has proven to be significant.

Thus Kenen-Yudin (1965) and Bhagwati (1964) have independently proposed that any return to labour, in excess of the average unskilled wage, may be treated as return to "human capital." In this case this return can be capitalised and the resulting estimate of human capital can be added to the estimated "physical" capital, yielding an adjusted capital magnitude and

¹The calculations underlying this paper were possible thanks to financial assistance granted by the Center for International Studies, M.I.T. and the International Economics Workshop at Columbia University. Research support by the National Science Foundation is also acknowledged. P. S. Shanmukham and Andrea Beller made the necessary calculations.

²For a detailed review of these attempts, see Bhagwati's review (1969, Chapter I and Addendum).

hence an adjusted capital/labour intensity in the export and import-competing industries.³

Alternatively, the actual computational technique may take the returns themselves and estimate the ratio of returns to (physical and human) capital to returns to unskilled labour, as has recently been done for Germany by Roskamp and McMeekin (1968). For perfect markets, and accurately recorded information, this method should yield the same capital/labour ratio rankings of exports and import-competing activities. In absence of these ideal conditions, however, we would be well-advised to cross-check our results by using both the capital and the returns estimates.

Finally, Hal Lary (1968) has recently proposed that value added per employee is a good approximation to the capital/labour intensity of an activity since returns to physical capital, investment in human beings, and investment in land as well, would account for the overwhelming bulk of it.⁴ Since capital estimates are notoriously unreliable, and since investment in factors (such as land) other than labour also should be taken into account in estimating total capital, Lary's method has certain definite advantages.

In this paper, therefore, we present estimates of the capital/labour intensities of India's exports and import-competing activities, for the 1953-54 pattern of trade, using the entire range of techniques for adjusting the capital estimates:

³This approach was used in Indian data in an earlier paper of Bhagwati and Bharadwaj (1967). We have summarised the results of this paper in Section II.

⁴There are some difficulties here, arising from phenomena such as monopoly rents. For a critical discussion, see Bhagwati (1969, Addendum to Chapter I).

- (i) the Bhagwati-Bharadwaj-Kenen-Yudin (BBKY) method (Section II);
- (ii) the Roskamp-McMeekin (RM) method (Section III); and
- (iii) the Lary method (Section V).

Adjustments for human capital by all three methods confirms that the Indian exports are relatively labour-intensive; the findings are thus consistent with the Heckscher-Ohlin theory. However, the BBKY method indicates that exports are skill-intensive whereas the RM method indicates the opposite: a phenomenon on which we comment at some length (Section V).

I: Bharadwaj's Unadjusted Results

Bharadwaj (1962) had earlier computed, following Leontief's pioneering exercise, the factor contents of an export vector containing Rs.10 million worth of composite goods; and of a vector of import substitutes identically, using the (36 x 36) Indian Statistical Institute input-output table for 1953-54 and using the trade pattern of the same year.⁵ The resulting factor requirements, in terms of physical capital and labour, for the vectors of exports and import replacements have been reproduced here in Tables 1 and 2 respectively.

The results show that Indian exports absorb relatively more of labour and relatively less of physical capital than import replacements of equal value. These results are thus consonant with the predictions of the Heckscher-Ohlin theory.

Our concern now is, however, to see how these results stand to be

⁵Cf. Bharadwaj (1962, pp. 30-70) for further details.

modified when adjustment is made in a number of possible ways for the presence of human capital.

II: The Bhagwati-Bharadwaj-Kenen-Yudin Method⁶

Our first method of adjusting the capital estimates consists in approximating the differential between skilled and unskilled wages as the returns to human capital.

For this purpose, we had to estimate both the wage differential, and the proportion of skilled to total labour, in each of the 36 sectors. Since each sector, in turn, is composed of several "industries" and complete information was not available for all industries in each sector, we used the estimates for the industries, where available, and turned them into corresponding sectoral estimates by using alternatively (i) the industry outputs and (ii) the industrial employment, as weights. The estimates, as also the weights used, are reproduced in Table 3. Note, in particular, that we assumed zero human capital in Agriculture (Sector I) and, for Sectors 35 and 36 we had to use the "corresponding" averages in other sectors in view of the unavailability of direct information.

The estimation of the sectoral returns to human capital, and the resulting estimates of returns to human capital (by sector) corresponding to the composite bundles of exports and import-substitutes, then involved a straightforward calculation of:

$$\sum_{i=1}^n (W_{is} - W_{iu}) \cdot \frac{1_{is}}{100} \cdot d_i \cdot \frac{Q_i}{100} \cdot L,$$

⁶The pioneering empirical study, using this method, is the important work of Kenen and Yudin (1965) on the U. S. results of Leontief.

where W_{is} = average daily wage for the "skilled" labour in the i th industry of the sector; W_{iu} = average daily wage for the "unskilled" labour in the i th industry of the sector; l_{is} = percentage of skilled workers to total employment in the i th industry; d_i = average number of working days, in the year of the i th industry; Q_i = percentage contribution to sectoral output (or employment as the case may be) of the industry i , ($i = 1, \dots, n$ = number of industries in the sector); and L = direct and indirect labour requirements of the composite commodity exports (or import replacements, as the case may be) in that sector.

But these estimates related to the returns to human capital. We then had to capitalise these returns into estimates of human capital itself. We thus had to estimate the rates of return on human capital. Table 4 contains these estimates, as calculated by Harberger (1965). Since it was not possible for us to separate out the different skill-types in our estimate of the skill component in wages, by level of education attained, we took three alternative, illustrative estimates, spanned by Harberger's calculations, at 10%, 15%, and 17%. The resulting estimates of human capital, directly and indirectly employed in the 36 sectors are put together in Tables 5(a) and 5(b), for exports and competitive imports respectively.

On aggregating the physical and human capital estimates, and recomputing the capital-labour intensities of Indian exports and import-substitutes, we then obtained the results presented in Table 6. It is interesting that the results show uniformly, on all the alternative assumptions about weights and rates of return, a narrowing of the relative labour-intensity of Indian exports. Thus the conclusion that Indian exports are labour-intensive survives the adjustment for human capital. On the other hand, Indian exports

appear to be skills-intensive: a phenomenon on which we comment later, when we have presented results for the other two methods of adjustment.

III: The Roskamp-McMeekin Method

We also ran our exercise through the Roskamp-McMeekin method which uses data on returns rather than on stocks. In doing this, we had to arrive at estimates of the returns to physical capital, as distinct from estimates of the physical capital stock in different sectors. This innovation in the procedure meant that we had, at times, to resort to new sources of data for our estimates: the comparability of these sources with the sources used for estimates of returns to human capital (used in the Bhagwati-Kenen procedure as also the current one) has been discussed in the Appendix on Sources. The estimates of returns to physical capital included profits and interest payments; remuneration to managing agents was excluded on the ground that it constituted wages for management, whereas rent on land was generally counted in as return to capital.

Table 7 gives the results of the calculations. The rows list the sectors. Columns (5) and (6) give the estimates of physical and human capital coefficients, defined as the corresponding rentals per unit output of the sector. Column (7) gives the labour coefficients, defined as the unskilled wages per unit output of the sector whereas Column (8) gives the sum of human and physical capital by sector. Estimates based on these data are presented in Table 8.

Exports continue to be labour-intensive despite the adjustments made for human capital: the adjusted capital intensity of the export sector, relative to the import sector, is 0.8586, so that exports still continue to

be labour-intensive (as shown in Table 8). However, the skill factor works towards widening the difference in the capital-labour ratios in the two groups: as Table 8 records, the physical capital intensity of the export sector (indicated by index L_1) is higher, at 0.9539, than the adjusted capital-intensity at 0.8586. Exports thus appear as less skill-intensive than imports: a finding which is also confirmed by the alternative presentation of the same results in terms of index L_2 in Table 8 which shows exports to have a lower ratio (than imports) of human capital to unskilled wages and by index L_3 which shows again that exports have a lower ratio of human capital to physical capital.

IV: BBKY vs. RM Results

The preceding two sections thus indicate that Indian exports continue to be labour-intensive by either adjustment. On the other hand, the BBKY method shows exports to be skill-intensive whereas the RM method shows the opposite.

The latter contradiction is to be explained partly on statistical and partly on conceptual grounds. Statistically, the differences are likely to follow from the occasional differences in the sources used (see Appendix) in view of the differences in the kinds of data required and also from the consequent, occasional differences in the dates for which data have been available for the calculations. At a conceptual level, however, three important points need to be made:

(1) The BBKY measure uses per-labour-unit calculations whereas the RM measure uses unskilled wages: this could lead to differences insofar as the unskilled wage per man differs among sectors in the calculations.

(2) The problem of profit estimation is pertinent: in some cases, we had to deal with losses, which we treated as zero profits, whereas the corresponding sectors in the BBKY type calculation, based on the capital-stock approach, carried positive capital estimates.

(3) The general problem of profit rate variations among sectors is also pertinent, just the same as the question of differences in unskilled wage rates among the different sectors.

These differences lead to differential ranking of individual sectors by their skill-indices, depending on which skill-index is chosen. In Table 9(a), we have computed four alternative skill-intensity indices for each sector, two based on each of the BBKY and RM approaches. The two BBKY-type indices are: Y_I which takes the ratio of the capitalised values of human to physical capital and Y_{II} which takes the ratio of the capitalised value of human capital to quantity of labour employment. The two RM-type indices are: Y_{III} which takes the ratio of incomes accruing to human and physical capital and Y_{IV} which takes the ratio of incomes accruing to human capital and (unskilled) labour.

Using the four series given above indicating sectoral human capital intensity computed by different methods, we have calculated Rank Correlation coefficients employing the formula: $\rho = 1 - \frac{6 \sum d_i^2}{n(n^2-1)}$ (where ρ = the Rank Correlation coefficient), due to Spearman. The results of our computations are given in Table 9(b).

It will be observed that series (Y_{II}), (Y_{III}), and (Y_{IV}) are un-correlated with series (Y_I). Thus, the reversed ranking of Indian imports and exports by their skill-intensity, in the BBKY and RM exercises, appears to be attributable, at least in part, to the fact that the relative skill-intensities of individual sectors happen to be dissimilar under the two methods.

Nonetheless, we are inclined to accept the RM results because the capital stock data, which underlie the BBKY exercises, are (as everywhere) fairly unreliable. On the other hand, we ought to admit that the superior plausibility of the RM results needs to be qualified on three empirical and theoretical grounds:

i) As we noted, when presenting the BBKY-type results in our earlier paper (1967, p. 140) "...the weight of plantations, mining and textiles in Indian exports, for our period, is very considerable; and these sectors have a high percentage of 'skilled' workers. On the other hand, the overall skill content, in labour, in import competing activities such as iron and steel and light engineering industries (many of which have a large base in the small-scale sector in India) turns out to be lower: the growth of more complex technology in these industries, involving perhaps greater overall skill levels, must have come in the period beyond that covered by our wage rates and occupational data, which generally span the period 1955-1959."

ii) "...it is important to remember that human capital and other capital may be substitutes rather than complements. Thus, it may not be paradoxical at all to find that skill-intensiveness is not directly related to capital-intensity." (1967, p. 140) Hence, the fact that exports are labour-intensive may be consistent with their being skills-intensive as well.

iii) Finally, since we do not distinguish between different kinds of skills, it may well be that India, owing to massive expansion of college education, has an abundance of semi-skilled labour and thus her exports are skill-intensive.⁷

⁷ Clearly, therefore, more work will be necessary to examine each sector's skill-intensiveness more intensively, through micro-studies via fitting of production functions which, at a minimum, explicitly introduce skilled labour as a separate factor of production, to distinguish between the two alternative hypotheses.

V: The Lary Method

The last alternative method used by us related to the calculation (à la Lary) of the value added per employee as the index of capital-intensity.

Table 10 presents these calculations by sector. When multiplied into the production-requirements columns (3) and (4) of Table 7, they yield the relative capital-intensity of exports as .6692. This confirms again that exports are labour-intensive in relation to imports, in consonance with the Heckscher-Ohlin theory.

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TABLE 1

Factor Requirements of Composite Commodity Exports (1953-54)

Sector No. and Name	Capital Requirements (In Rs.)	Labour Requirements (In numbers)
1	2	3
1. Agriculture	1582168.1450	6105.74200
2. Plantations	82898.9742	78.50598
3. Animal husbandry	698624.0064	2705.26959
4. Coke and Coal Mining	287245.6540	31.43180
5. All other minings	1415107.9439	142.57416
6. Iron and Steel	239883.9345	6.68340
7. Non-Ferrous Metals	38416.6902	6.52482
8. Engineering	102683.9268	18.80658
9. Chemicals	220744.6800	14.94750
10. Cement	14014.2940	1.31800
11. Other building materials	17808.5600	9.44944
12. Food, Drinks & Tobacco	820008.2800	135.16620
13. Cotton Textiles	933008.3532	153.86656
14. Other Textiles	67282.0284	14.57504
15. Jute and other Fibre	1138656.6100	348.56835
16. Glass and Ceramics	3958.2807	0.73711
17. Leather and Rubber	21795.1080	7.08784
18. Paper, Printing & Stationery	76313.8041	25.64943
19. Electricity (generation, transformation and distribution)	250257.4482	7.76570
20. Metalware and Metal Working	2846.2590	3.21975
21. Building Material and Wood Manufacture	4860.1944	10.00040
22. Textile and Textile Products	47318.7150	66.51225
23. Food, Drinks, and Tobacco	4813.4310	18.69966

TABLE 1 (cont.)

1	2	3
*24. Glass and Ceramics	—	—
*25. Leather and Leather Products	—	—
26. Other Products (Small Scale)	32583.4121	72.44112
27. Railways and Communication	783090.1275	29.95025
28. Other Transport	313570.5521	92.86889
29. Trade and Distribution	264395.9143	795.02241
30. Banks, Insurances and Cooperatives	9796.3290	7.48764
31. Professions	5783.1768	86.48358
*32. Constructions	—	—
*33. Residential Property	—	—
34. Public Administration	1057.8576	10.86840
35. Defence Materials (including explosives)	4243.0400	0.69180
36. Unclassified--large scale	31342.8697	10.16063
Total (approx.)	9.517 million 11022	

* The row entries for these sectors do not appear in the inverse since they contribute only to final Demand and did not participate directly--at any rate not significantly--in the foreign trade during that year.

TABLE 2

Factor Requirements of Composite Commodity, Competitive
Import Replacements (1953-54)

Sector No. and Name	Capital Requirements (In Rs.)	Labour Requirements (In numbers)
1	2	3
1. Agriculture	1072025.2734	4137.05064
2. Plantations	36995.1946	35.03474
3. Animal Husbandry	377493.3696	1461.76101
4. Coke and Coal Mining	377990.9827	41.36159
5. All other Minings	4928707.8260	496.57440
6. Iron and Steel	1704774.5889	47.49668
7. Non-Ferrous Metals	334611.1839	56.83149
8. Engineering	1870327.2588	342.55078
9. Chemicals	1024315.1256	69.36045
10. Cement	18207.9492	1.71240
11. Other building materials	22250.4100	11.80634
12. Food, Drinks & Tobacco	253183.4760	41.73354
13. Cotton Textiles	670871.4705	110.63640
14. Other Textiles	206563.5234	44.74704
15. Jute and other Fibre	32147.9200	9.84120
16. Glass and Ceramics	24216.9279	4.50967
17. Leather and Rubber	16444.3620	5.34776
18. Paper, Printing & Stationery	233693.8894	78.54562
19. Electricity (generation, transformation and distribution)	289824.5310	8.99350
20. Metalware and Metal working	2053.0900	2.32250
21. Building Material and Wood Manufacture	6022.1232	12.39120
22. Textile and Textile Products	111.0540	0.15610
23. Food, Drinks & Tobacco	1582.0980	6.14628

TABLE 2 (cont.)

1	2	3
*24. Glass and Ceramics	—	—
*25. Leather and Leather Products	—	—
26. Other Products (Small Scale)	5049.2533	11.22576
27. Railways and Communication	569070.8982	21.76482
28. Other Transport	112987.9413	33.46317
29. Trade and Distribution	109283.0151	328.60737
30. Banks, Insurances and Cooperatives	4029.0910	3.07956
31. Professions	4721.7276	70.61031
*32. Constructions	—	—
*33. Residential Property	—	—
34. Public Administration	1835.6580	18.85950
35. Defence Materials (including explosives)	41176.9920	6.71364
36. Unclassified--large scale	74975.0842	24.30518
TOTAL (approx.)	14.43 million	7547

* The row entries for these sectors do not appear in the inverse since they contribute only to final Demand and did not participate directly--at any rate not significantly--in the foreign trade during that year.

TABLE 3

Sector Number and Name	Average wage of skilled labour (per day) Rs.	Average wage of unskilled labour (per day) Rs.	Percentage of skilled workers to total employment	Weights (according to relative contribution to sectoral output)	Weights (according to relative contribution to sectoral employment)
(1)	(2)	(3)	(4)	(5)	(6)
<u>Sector 1: Agriculture</u>	--	--	--	--	--
<u>Sector 2: Plantations:</u>					
Coffee	2.91	1.24	10.51	8.76	16.30
Tea	2.87	1.67	42.34	80.34	79.82
Rubber	2.87	1.53	66.46	10.90	3.88
				100.00	100.00
<u>Sector 3: Animal Husbandry</u>	--	--	--	--	--
<u>Sector 4: Coke & Coal Mining</u>					
Coal Mining etc,	5.08	2.95	91.22	--	100.00
<u>Sector 5: All other minings</u>					
Manganese Ore	3.18	1.54	67.33	68.06	58.10
Iron Ore	3.25	1.41	13.19	12.36	22.11
Mica	2.40	1.21	90.82	19.58	19.79
				100.00	100.00
<u>Sector 6: Iron & Steel</u>					
Primary Products	6.20	2.91	52.89	73.10	38.02
Secondary Products	4.89	2.70	48.00	26.90	61.98
				100.00	100.00

Table 3 (cont.)

(1)	(2)	(3)	(4)	(5)	(6)
Sector 7: Nonferrous metals					
Primary Products	5.91	2.82	49.88	50.02	21.36
Secondary Products	4.36	2.66	56.97	49.98	78.64
				<u>100.00</u>	<u>100.00</u>
Sector 8: Engineering					
Bicycles	6.49	3.44	57.23	2.17	2.98
Sewing Machines	5.72	3.20	65.44	0.69	1.62
Electric Lamps	5.34	2.82	38.04	2.01	0.99
Electric Fans	5.01	2.84	65.44	2.01	2.10
General Engg. and Electric Engines	5.29	2.80	62.72	60.85	50.13
Textile Mach. & Accessories	6.17	3.20	58.99		6.44
Manufacture & Repair of motor vehicles	4.79	2.55	61.43	8.09	24.36
Aircraft building and repairing	7.06	3.08	60.12	2.57	2.13
Bolts, Nuts	5.88	2.76	66.15	9.37	1.47
Railway Workshops	5.88	2.76	66.15	2.71	7.78
				<u>100.00</u>	<u>100.00</u>
Sector 9:					
Chemicals (incl. drugs)	7.84	3.11	33.50	76.85	66.08
Soap	5.56	2.90	34.33	9.64	11.78
Paints and Varnishes	5.59	3.18	32.93	8.85	7.22
Starch	5.10	2.22	31.58	1.53	4.18
Turpentine and Rosin	5.56	3.14	38.87	0.78	1.02
Lac	6.15	3.12	8.24	2.35	9.72
Plastics (including gramophone records)	--	--	--	--	--
				<u>100.00</u>	<u>100.00</u>

Table 3 (cont.)

(1)	(2)	(3)	(4)	(5)	(6)
<u>Sector 10: Cement</u>					
Cement	5.74	2.45	43.30	79.22	33.06
Asbestos & Asbestos products	4.21	2.45	44.39	8.88	4.14
Bricks and Tiles etc.	3.80	1.98	28.36	5.08	54.41
Hume pipes and other products	6.49	2.50	26.20	6.82	8.39
				<u>100.00</u>	<u>100.00</u>
<u>Sector 11: Other Building Materials</u>					
Plywood and tea chests	5.37	1.20	38.38	5.98	7.65
Matches	5.26	1.20	15.85	46.66	31.49
Saw Milling	4.18	2.58	41.24	10.95	14.51
Woodware including furniture	4.02	2.55	64.04	23.27	12.91
Bricks, tiles, lime etc.	3.80	1.98	28.36	13.14	33.44
				<u>100.00</u>	<u>100.00</u>
<u>Sector 12: Food, Drinks, Tobacco</u>					
Sugar	3.28	2.22	31.32	13.69	23.45
Wheat Flour	4.41	2.82	30.34	26.025	1.48
Rice Milling	4.96	2.86	21.71		10.93
Biscuit and Confectionary	3.14	1.79	42.92	1.25	1.16
Tea Manufacturing	2.91	1.68	34.43	22.62	15.72
Vegetable Oils	4.53	2.85	30.84	22.04	8.63
Fruits and Vegetable Preservation	4.50	2.40	35.30	5.37	0.42
Cigarettes, etc. } Tobacco Products }	3.00	1.67	56.52	11.16	25.80
Groundnut decarcating	3.39	1.06	5.45	0.93	11.55
Distilleries and breweries	4.62	2.16	38.44	2.20	0.86
				<u>100.00</u>	<u>100.00</u>

Table 3 (cont.)

(1)	(2)	(3)	(4)	(5)	(6)
<u>Sector 13: Cotton Textiles</u>					
Cotton Textiles	4.61	3.01	15.85	81.15	82.27
Ginning and Pressing	4.97	3.00	30.24		13.93
Textile bleaching and dying	5.08	3.03	68.65		1.91
Hosiery and other knitted goods	4.10	4.464	2.69	18.85	1.05
Webbing Crawn Fabrics	3.85	2.48	75.21		0.62
Thread & Thread ball making	4.32	2.46	55.34	<u>100.00</u>	<u>0.22</u>
					<u>100.00</u>
<u>Sector 14: Other Textiles</u>					
Woolen Textiles	4.05	2.80	75.67	29.19	20.40
Silk Textiles	4.87	2.37	78.02	14.94	66.53
Hosiery and other knitted goods	4.10	2.48	78.53	<u>55.17</u>	<u>13.07</u>
				<u>100.00</u>	<u>100.00</u>
<u>Sector 15: Jute and other Textiles</u>					
Jute Pressing	3.63	2.76	62.48	98.23	96.77
Rope making	5.30	2.63	78.02	0.69	1.47
	4.15	2.76	71.02	<u>1.08</u>	<u>1.76</u>
				<u>100.00</u>	<u>100.00</u>
<u>Sector 16: Glass and Glassware</u>					
Enamel-ware	4.40	2.70	45.10	5.73	4.64
Glass and Glassware	3.46	1.97	50.67	57.34	55.96
Refractories	3.89	1.97	28.14	<u>36.93</u>	<u>39.40</u>
				<u>100.00</u>	<u>100.00</u>
<u>Sector 17: Leather and Rubber</u>					
Rubber and Rubber Manufactures	3.63	1.53	38.71	51.24	54.29
Footwear & Leather Manufactures	4.93	2.94	59.59	38.34	10.24
Tanning	3.50	2.90	34.33	<u>10.42</u>	<u>35.47</u>
				<u>100.00</u>	<u>100.00</u>

Table 3 (cont.)

(1)	(2)	(3)	(4)	(5)	(6)
<u>Sector 18: Paper Printing and Stationery</u>					
Paper and Paper board	4.39	2.57	35.22	50.98	22.91
Printing and bookbinding	4.50	2.46	71.58	49.02	77.09
				<u>100.00</u>	<u>100.00</u>
<u>Sector 19: Electricity</u>					
Electricity Generation & transformation	5.50	2.62	52.63	---	---
				<u>100.00</u>	<u>100.00</u>
<u>Sector 20: Small Scale Sector</u>					
Metalware and metalworking	2.90	1.68	34.43	100.00	100.00
<u>Sector 21: Small Scale Building</u>					
Material and other industries	2.05	1.50	64.04	100.00	100.00
<u>Sector 22: Textiles and garments</u>					
Hosiery and allied products	2.50	1.80	30.60	100.00	100.00
<u>Sector 23: (Small Scale)</u>					
Food, drinks and Tobacco					
Bidi					
Flour mills etc.	1.94	1.28	89.67	100.00	100.00
<u>Sector 24: --</u>	--	--	--	---	---
<u>Sector 25: Leather footwear & other goods</u>					
	4.65	2.95	74.15	100.00	100.00
<u>Sector 26: Small Scale Industries(n.e.c.) --</u>					
		--	--	---	---
<u>Sector 27: Railways</u>					
	5.32	2.85	36.72	86.07	82.96
Posts and Telegraphs	3.10	1.07	81.33	13.93	17.04
				<u>100.00</u>	<u>100.00</u>

Table 3 (cont.)

(1)	(2)	(3)	(4)	(5)	(6)
<u>Sector 28:</u>					
Air transport	5.10	1.50	64.82	29.16	83.44
Shipping					
Tramways	4.04	3.49	90.84	<u>70.84</u>	<u>16.56</u>
				<u>100.00</u>	<u>100.00</u>
<u>Sector 29: Wholesale Trade & distribution</u>	3.12	1.07	80.67	100.00	100.00
<u>Sector 30: Banks, Insurance, etc.</u>	3.12	1.07	80.67	100.00	100.00
<u>Sector 31: Professional Journals and Institutional Services etc.</u>	3.12	1.07	80.67	100.00	100.00
<u>Sector 32: Construction</u>	--	--	---	---	---
<u>Sector 33: Residential Property</u>	--	--	---	---	---
<u>Sector 34: Public Administration</u>					
(same as sector 30)	3.12	1.07	80.67	100.00	100.00
<u>Sector 35: Defence materials (average of Engineering and chemicals)</u>					
				[Average of Sectors 8 and 9]	
<u>Sector 36: Large-Scale--unclassified</u>					
				[Average of Sectors 8, 9, 11 and 12]	

TABLE 4

Estimated Rates of Return to Investment in Education in India

	Assumption I ^b	Assumption II ^a
Graduate-postgraduate compared with primary	15.0	14.1
Secondary compared with primary	11.9	10.0
Graduate-postgraduate compared with secondary	16.9	16.3

Source: Harberger (1965).

- (a) Assumption II is that the direct costs of education amount to 50 per cent of foregone earnings.
- (b) Assumption I is more conservative. It takes direct costs of the first year of secondary school to be 12 per cent of the earnings of a primary school graduate aged 14; of the second year of secondary school, to be 16 per cent of the earnings of a primary school graduate aged 15; of the third year, to be 20 per cent of the earnings of a primary school graduate aged 16; and of the fourth year, to be 24 per cent of the earnings of a primary school graduate aged 17. For the successive years of higher education, the direct costs are taken to be 30, 35, 40, 45, 50 and 50 per cent of the earnings of a secondary school graduate aged 18, 19, 20, 21, 22 and 23, respectively.

TABLE 5A

Human Capital Estimates by Sector for Exports

Rs.

Sector No.	Output Weights			Employment Weights		
	R = 10%	R = 15%	R = 17%	R = 10%	R = 15%	R = 17%
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	---	---	---	---	---	---
2	12589192	8392793	7405407	11333476	7555646	6666747
3	---	---	---	---	---	---
4	18810176	12540117	11064809	18810176	12540117	11064809
5	43611568	29074378	25653864	39976552	26651033	23515618
6	2857525	1905017	1680897	2413400	1608933	1419647
7	2350148	1566765	1382440	2056813	1371209	1209890
8	9197095	6131397	5410056	8673806	5782537	5102239
9	6062738	4041825	3566316	5544767	3696511	3261628
10	561603	374402	330355	378350	252233	222559
11	2015959	1343973	1185858	1940578	1293719	1141516
12	17307491	11538326	10180877	16635869	11090580	9785806
13	18753672	12502446	11031572	15508328	10338887	9122548
14	32737280	21824853	19257224	13176644	8784427	7750965
15	57869262	38579506	34040742	59424651	3961643	34955676
16	132468	88312	77922	131404	87603	77292
17	2163114	1442076	1272420	1446747	964498	851028
18	7701696	5134464	4530409	9400320	6266880	5529600

TABLE 5A (cont.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
19	4296415	2864277	2527303	4296415	2864277	2527303
20	351520	234347	206776	351520	234347	206776
21	1042512	695008	613242	1042512	695008	613242
22	3704220	2469480	2178953	3704220	2469480	2178953
23	2523276	1682184	1484280	2523276	1682184	1484280
24	---	---	---	---	---	---
25	---	---	---	---	---	---
26	---	---	---	---	---	---
27	11047820	7365213	6498718	11301130	7534087	6647724
28	13775830	9183886	8103429	7894220	5262813	4643659
29	404944848	269963232	238202852	404944848	269963232	238202852
30	4519795	3013197	2658703	4519195	3013197	2658703
31	52202665	34801776	30707450	52202665	34801776	30707450
32	---	---	---	---	---	---
33	---	---	---	---	---	---
34	6560145	4373430	3858909	6560145	4373430	3858909
35	308941	205961	181730	308941	205961	181730
36	4464460	2976307	2626153	4464460	2976307	2626153

TABLE 5B

Human Capital Estimates by Sector for Imports

Rs.

Sector No.	Output Weights			Employment Weights		
	R = 10%	R = 15%	R = 17%	R = 10%	R = 15%	R = 17%
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	---	---	---	---	---	---
2	5618228	3745485	3304840	5050892	3367261	2971113
3	---	---	---	---	---	---
4	24752420	16501613	14560247	24752420	16501613	14560247
5	151895128	101263419	89350075	139040440	92693627	81788494
6	20307925	13638617	11945835	17151475	11434313	10089103
7	20469292	13646194	12040759	17916266	11944173	10538977
8	167520302	111680201	98541354	157990805	105327200	92935768
9	28131566	18754377	16547977	25730047	17153360	15135332
10	730051	486701	429442	490868	327245	288758
11	2518203	1678802	1481296	2424275	1616183	1426044
12	5343618	3562412	3143305	5136285	3424190	3023697
13	13484872	8989915	7932277	11151208	7434139	6559534
14	15901322	10600881	9353719	20611198	13740799	12124234
15	1633797	1089198	961057	1677753	1118502	986914
16	811300	540867	477235	804650	536433	473324
17	1838046	1225364	1081204	1091400	727600	642000
18	23584320	15722880	13873129	28786176	19190784	16933045

TABLE 5B (cont.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
19	4975680	3317120	2926871	4975680	3317120	2926871
20	253760	169173	149271	253760	169173	14927
21	1291744	861163	759849	1291744	861163	759849
22	8580	5720	5047	8580	5720	5047
23	829464	552976	487920	829464	552976	487920
24	---	---	---	---	---	---
25	---	---	---	---	---	---
26	---	---	---	---	---	---
27	8028905	5352603	4722885	8212500	5475000	4830882
28	12634110	8422740	7431829	24792625	16528417	1458390
29	167376440	111584293	98456729	167376440	111584293	98456729
30	1858945	1239297	1093497	1858945	1239297	1093497
31	42621415	28414276	25071421	42621415	28414276	25071421
32	---	---	---	---	---	---
33	---	---	---	---	---	---
34	11383985	7589320	6696462	11383985	7589320	6696462
35	2998953	1999302	1764090	2998953	1999302	1764090
36	10679760	7119840	6282212	10679760	7119840	6282212

TABLE 6

Adjusted and Unadjusted Capital/Labour Ratios of the Composite
Commodity bundles "a crore rupees worth of" Exports and
Import Replacements

Estimate	Weights	Assumed Rate of Return	Capital Require- ments (Rs. 000)		Labour Require- ments (in nos.)		Ratio of Capital to Labour Requirements: Exports/Im- ports $[(C/L)_E/(C/L)_I]$
			Exports	Imports	Exports	Imports	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I	Output Weights Basis	10% I	16916	21922	11022	7547	$1538.85/2904.77 = 0.5297$
II		15% II	14480	19424	11022	7547	$1313.71/2573.74 = 0.5104$
III		17% III	13896	18836	11022	7547	$1260.73/2495.86 = 0.5152$
IV	Employment Weights Basis	10% IV	16626	21798	11022	7547	$1508.46/2888.35 = 0.5223$
V		15% V	14256	19342	11022	7547	$1293.45/2562.80 = 0.5047$
VI		17% VI	13699	18763	11022	7547	$1242.85/2486.20 = 0.4999$
VII	Unadjusted	VII	9517	14428	11022	7547	$839.03/1910.00 = 0.439$

TABLE 7

Adjusted Capital, Rental, and Labour Wage Coefficients by Sector

Sector No.	Sector	Production re- quirements of exports (I-A) ⁻¹ x E	Production re- quirements of imports (I-A) ⁻¹ x I	Physical capital coefficients	Human capital coefficients	Unskilled labour wages coefficient	Capital co- efficients (physical & human)
1	2	3	4	5	6	7	8
1	Agriculture	40,45,138.4	24,18,858.4	0.24752	-	0.04549	0.24752
2	Plantations	1,89,095.5	74,986.1	0.07065	0.01384	0.66603	0.08449
3	Animal Husbandry	17,59,870.1	8,59,693.6	0.24752	-	0.15685	0.24752
4	Coke & Coal	1,46,193.9	1,80,743.2	0.29727	0.05843	0.25179	0.35569
5	All other mining	6,65,830.5	20,79,711.9	0.11540	0.02872	0.05848	0.14412
6	Iron and Steel	1,81,944.4	11,94,351.6	-	0.14105	0.06895	0.13400
7	Non-ferrous metals	78,426.4	6,31,383.3	0.01279	0.03796	0.05438	0.05075
8	Engineering	1,40,648.4	26,50,880.1	0.00846	0.03926	0.06595	0.04772
9	Chemicals	3,40,972.8	13,91,652.4	0.01394	0.01185	0.01671	0.02579
10	Cement	14,488.5	17,221.0	0.05350	0.03824	0.04969	0.09173
11	Other Building Materials	40,375.9	45,807.8	-	0.02307	0.01515	-
12	Food, drink, tobacco, etc.	25,90,575.6	6,99,674.6	0.01451	0.00307	0.00431	0.01758
13	Cotton textiles	22,33,760.8	13,88,451.1	0.00932	0.5718	0.09132	0.06651
14	Other textiles	2,13,314.8	5,62,685.3	-	0.01132	0.02013	0.00174
15	Jute and other Fibre	26,98,684.8	65,950.3	0.04111	0.05972	0.15600	0.10083
16	Glass & Ceramics	7,587.7	41,238.2	-	0.03264	0.06210	-
17	Leather & Rubber	97,656.2	67,320.1	0.02864	0.04494	0.01867	0.07358
18	Paper, Printing & Stationery	1,53,644.9	4,15,859.0	0.00297	0.05011	0.07115	0.05309
19	Electricity	81,932.7	90,364.3	0.19919	0.10383	0.09142	0.30302
20	Metalware & metalworking	13,750.8	9,343.1	0.16270	-	0.31042	0.16270

Sector No.	Sector	Production re- quirements of exports (I-A) ⁻¹ x E	Production re- quirements of imports (I-A) ⁻¹ x I	Physical capital coefficients	Human capital coefficients	Unskilled labour wages coefficient	Capital co- efficients (physical & human)
1	2	3	4	5	6	7	8
21	Building material & wood manufacturing	27,240.1	31,142.6	0.24815	-	0.53803	0.24815
22	Textile & Textile products	2,20,906.8	448.9	0.13862	-	0.45338	0.13862
23	Food, drinks, tobacco, etc.	39,284.6	11,446.0	0.20127	-	0.13440	0.20127
24	Glass & Ceramics	-	-	-	-	-	-
25	Leather & Leather products	-	-	0.51939	-	0.07859	-
26	Other products	1,81,040.7	23,518.6	-	-	-	-
27	Railway and communication	1,65,403.2	1,98,686.1	0.10137	0.16950	0.21487	0.27088
28	Other transport	1,24,389.6	90,713.5	0.17610	0.02153	0.07790	0.19763
29	Trade & distribution	10,08,116.7	8,44,980.5	0.73650	0.05294	0.01671	0.78944
30	Banks, Ins. & Co-operatives	30,793.7	25,735.6	0.10168	0.35757	0.04747	0.45925
31	Professions	62,763.1	54,180.9	0.15609	0.40957	0.28151	0.56566
32	Constructions	-	-	-	-	-	-
33	Residual property	-	-	-	-	-	-
34	Public Administration	13,607.9	21,064.9	-	0.75064	0.24935	0.75064
35	Defence materials	6,403.1	56,273.1	0.01120	0.02555	0.04133	0.03675
36	Unclassified	24,251.2	67,435.6	0.00923	0.01931	0.02553	0.02423

Notes: Column (8) is the sum of columns (5) and (6). However, as with Sector 6, there are differences which arise from the fact that losses are treated as zero returns to physical capital in column (5), whereas they are subtracted from column (6) in coming to column (8).

TABLE 8

Adjusted Capital Rental to Unskilled Labour Wages and Related Ratios:
Exports divided by Imports

Measure	Values	Resulting Ratios
$L_1 = \begin{pmatrix} E_k \\ E_n \end{pmatrix} \quad \begin{pmatrix} I_k \\ I_n \end{pmatrix}$	$\frac{\begin{pmatrix} 26,09,041.690 \\ 15,65,854.920 \end{pmatrix}}{\begin{pmatrix} 18,90,707.010 \\ 10,82,406.640 \end{pmatrix}}$	0.9539
$L_2 = \begin{pmatrix} E_h \\ E_n \end{pmatrix} \quad \begin{pmatrix} I_h \\ I_n \end{pmatrix}$	$\frac{\begin{pmatrix} 5,21,719.260 \\ 15,65,854.920 \end{pmatrix}}{\begin{pmatrix} 6,42,787.780 \\ 10,82,406.640 \end{pmatrix}}$	0.5611
$L_3 = \begin{pmatrix} E_h \\ E_k \end{pmatrix} \quad \begin{pmatrix} I_h \\ I_k \end{pmatrix}$	$\frac{\begin{pmatrix} 5,21,719.260 \\ 26,09,041.690 \end{pmatrix}}{\begin{pmatrix} 6,42,787.780 \\ 18,90,707.010 \end{pmatrix}}$	0.5882
$L_4 = \begin{pmatrix} E_{h+k} \\ E_n \end{pmatrix} \quad \begin{pmatrix} I_{h+k} \\ I_n \end{pmatrix}$	$\frac{\begin{pmatrix} 31,26,188.960 \\ 15,65,854.920 \end{pmatrix}}{\begin{pmatrix} 25,17,010.690 \\ 10,82,406.640 \end{pmatrix}}$	0.8586

Notes: The calculations are based on Table 7.

E_k = Columns (3x5) = physical capital returns in producing stated exports

E_n = Columns (3x7) = unskilled labour wages in producing stated exports

E_h = Columns (3x6) = human capital returns in producing stated exports

E_{h+k} = Columns (3x8) = (total) adjusted capital returns in producing stated exports

I_k = Columns (4x5) = physical capital returns in producing stated imports

I_n = Columns (4x7) = unskilled labour wages in producing stated imports

I_h = Columns (4x6) = human capital returns in producing stated imports

I_{h+k} = Columns (4x8) = (total) adjusted capital returns in producing stated imports

TABLE 9(a)

Alternative Skill-Intensity Indices for Different Sectors

Sector Nos.	Skill-Intensity (Y _I): Human Capital (Capitalised) to Physical Capital (capitalised)	Skill-Intensity (Y _{II}): Human Capital (Capitalised) to Labour (numbers)	Skill-Intensity (Y _{III}): Human to Physical Capital (incomes)	Skill-Intensity (Y _{IV}): Human Capital to Labour (incomes)
1	-	-	-	-
2	101.24121	1,06,906.4	0.19589	0.02078
3	-	-	-	-
4	43.65642	3,98,962.7	0.01965	0.23206
5	20.54570	2,03,924.0	0.02489	0.49111
6	7.94141	2,85,037.1	-	2.04568
7	40.78344	2,40,123.8	2.96794	0.69805
8	59.71136	3,26,024.0	4.64066	0.59530
9	18.30995	2,70,401.4	0.85007	0.70916
10	26.71572	2,84,068.3	0.71477	0.76957
11	75.46780	1,42,227.7	-	1.52277
12	14.07098	85,363.9	0.02116	0.71230
13	13.40014	81,255.0	6.13519	0.62615
14	324.37860	14,97,412.0	-	0.56234
15	33.88160	1,10,679.0	1.45269	0.38282
16	22.31070	1,19,808.4	-	0.52560
17	66.16152	2,03,457.7	1.56913	2.40707
18	67.28093	2,00,178.4	16.87205	0.70429
19	11.44532	3,68,386.9	0.52126	1.13575
20	82.33509	72,784.2	-	-

TABLE 9(a) (cont'd)

Sector Nos.	Skill-Intensity (Y _I): Human Capital (Capitalised) to Physical Capital (capitalised)	Skill-Intensity (Y _{II}): Human Capital (Capitalised) to Labour (numbers)	Skill-Intensity (Y _{III}): Human to Physical Capital (incomes)	Skill-Intensity (Y _{IV}): Human Capital to Labour (incomes)
21	143.00004	69,498.0	-	-
22	52.18823	37,128.1	-	-
23	349.49760	89,957.9	-	-
24	-	-	-	-
25	-	-	-	-
26	-	-	-	-
27	9.40532	2,45,914.9	1.67209	0.78885
28	29.28810	98,890.8	0.12226	0.27638
29	1,021.01890	3,39,560.0	0.07188	3.16816
30	307.58430	4,02,422.7	3.51835	7.53255
31	6,017.76100	4,02,409.9	2.62393	1.45490
32	-	-	-	-
33	-	-	-	-
34	4,134.23310	4,02,398.7	-	3.01039
35	48.54114	2,97,717.5	2.28125	0.61819
36	94.95962	2,92,925.4	2.09209	0.75636

Notes: The first two columns of skill-intensity indices relate to the BBKY method; the last two columns refer to the RM method.

Source: Calculated from the data underlying, and in, Tables 1-8.

TABLE 9(b)

Spearman Rank Correlation Coefficients for
Different Skill-intensity Indices in Table 9(a)

Variables	Number of observations	Observed rank correlation	Value of ρ at 5% level of significance	Significance of observed correlation	Remarks
1) Y_I and Y_{II}	29	0.2212	0.3687	Insignifi- cant	Variables are linearly uncorrelated
2) Y_I and Y_{III}	20	0.2323	0.4438	Insignifi- cant	Variables are linearly uncorrelated
3) Y_I and Y_{IV}	25	0.1968	0.3975	Insignifi- cant	Variables are linearly uncorrelated

TABLE 10

Value Added Per Employee in Different Sectors: 1953-54

Sector No.	Sector Name	Value added (in Rupees) : Number of Employees (3)
(1)	(2)	
1	Agriculture	2,000.232
2	Plantations	388.196
3	Animal Husbandry	2,000.232
4	Coke & Coal	1,689.465
5	All other mining	1,903.357
6	Iron and Steel	4,629.847
7	Non-ferrous metals	2,182.027
8	Engineering	1,933.477
9	Chemicals	4,603.526
10	Cement	4,661.013
11	Other Building Materials	2,055.648
12	Food, drink, tobacco, etc.	2,910.895
13	Cotton textiles	1,773.388
14	Other textiles	2,066.035
15	Jute and other fibre	1,516.413
16	Glass and Ceramics	1,041.478
17	Leather and Rubber	3,222.304
18	Paper, printing and stationery	2,522.304
19	Electricity	6,044.242
20	Metalware and metalworking	504.422
21	Bldg. material and wood manufacturing	302.886

TABLE 10 (cont'd)

Sector No.	Sector Name	Value added (in Rupees) : Number of Employees
(1)	(2)	(3)
22	Textile and textile products	387.809
23	Food, drinks, tobacco, etc.	508.302
24	Glass and Ceramics	-
25	Leather and leather products	-
26	Other products	-
27	Railway and communication	1,813.272
28	Other transport	2,074.469
29	Trade and distribution	16,848.521
30	Banks, Ins. and co-operatives	5,486.667
31	Professions	989.546
32	Constructions	-
33	Residual property	-
34	Public administration	1,270.159
35	Defense materials	3,298.501
36	Unclassified	2,890.886

APPENDIX: Statistical Sources

Section II

In this section, human capital was treated as a separate factor by taking skill differential in the various industries as a proxy for this. The skill differential, in turn, was the difference between the actual wage paid and the return to "simple" labour. The sectoral figures were built up from industry estimates, using (alternatively) output and employment as weights.

In sectors 1 (Agriculture) and 3 (Animal husbandry) all labour was treated as unskilled and hence these sectors were omitted from the computation. Sectors 32 (Construction) and 33 (Residential property) were also omitted, as they did not participate in foreign trade.

For sectors 2, 4 through 19 and 28 the wage rates were obtained from the Occupational Wage Survey Reports (15) (16) and (17) and from the Report of the Pay Commission (4). For sectors 27 the Report of the Pay Commission (4), the Report of the Railway Board (18) and the Report of the Department of Posts and Telegraphs (1) were consulted. For sector nos. 29, 30, 31 and 34, for want of the relevant data, data from the Report of the Posts and Telegraphs Department (1) was used as representative. Similarly, for the small scale sectors, 20 through 26, representative figures had to be used. The average of the engineering and chemical sectors (numbers 8 and 9) was used for the Defense industries (sector 35), and the average of sectors 8, 9, 11 and 12 was used for the large-scale unclassified sector (number 36).

Section III

In this section factor incomes were used as proxies. Thus, profits represented physical capital, wages of unskilled labour represented labour and the skill differential represented human capital.

Next, profit was defined as non-wage income (i.e., value added net of depreciation minus wages and salaries) minus the imputed cost of management, tax provision, interest paid out and the establishment expenses. The estimates of these expenses were obtained from the balance sheet data of companies, published by the Reserve Bank of India (5).

The return to simple labour was obtained as a product of the wage-rate for unskilled labour (as given in the earlier Bhagwati-Bharadwaj study (1967)) the number of labourers and the number of working days. The skill-differential was thus defined as total wages and salaries less the return to unskilled labour.

The input-output table of the Indian economy (10) was the main source of data for sectors 1, 2, 4, 5, 20 through 26, 28, 29, 31, and 34. Representative figures were used for sectors 3 (same as that of 1), 35 (average of 8 and 9) and 36 (average of 8, 9, 11 and 12) as in the previous section. The CMI (3) and the SSMI (12) formed the basis of the computation in the case of sectors 6 through 19. The Report of the Railway Board (18) and the Report of the Department of Posts and Telegraphs (1) were used for sector number 27 and the Statistical Tables Relating to Banks (20) and the Statistical Statements Relating to the Cooperative Movement (19) and the Indian Insurance Year Book (7) were consulted for the data in respect of sector number 30. Sectors 32 and 33 were omitted as they did not participate in foreign trade.

Section IV

In this section value added per employee was computed by dividing the value added figure by the number of employees; sectoral estimates being obtained from industry figures by using output as weights.

In the case of sector numbers 1, 2, 4, 5, 20 through 26, 28 through 31, and 34 data relating to value added were taken from the Input-Output table (10). In the case of sector number 3 (animal husbandry), the coefficient was assumed to be the same as in that of sector number 1 (agriculture), as no employment figures were available for this sector. For sectors 6 through 19, value added and employment figures were taken from the Census of Indian Manufacturers (3). For sector number 27 the Reports of the Railway Board (18) and the Report of the Posts and Telegraphs Department (1) were consulted.

Data pertaining to employment for sectors 1 and 28 were taken from the Report of the Census of India 1951 (2), those for sectors 2 and 29 from the Indian Labour Statistics, 1959 (8), those for sector 4 from the Mineral Production of India, 1954 (11), for sectors 20 through 26 from the National Sample Survey Reports No. 42 and 43 (13) (14) and for sectors 30 and 34 from NCAER's Growth Without Inflation (6).

For sectors 35 and 36 representative figures, as in the case of sections II and III, were used. Similarly, sectors 32 and 33 were omitted as they did not participate in foreign trade.

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